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(54) **Flexbeam for rotor blades of helicopter and method for fabrication thereof.**

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Description

BACKGROUND OF THE INVENTION

This invention relates to a flexbeam for rotor blades of a helicopter and a method for the fabrication thereof and, more particularly, to a flexbeam of a hub structure provided with no bearing means and its fabrication method.

A helicopter rotor usually has a plurality of rotor blades, typically four in a cruciform shape, wherein the opposed blades are supported by flexible beams or flexbeam to be rotatable about the axis of rotation of a rotor mast. The flexbeam reacts against the centrifugal force between opposite blades and may terminate at a convenient radial position.

The flexbeam is generally classified into two types. One has a hub structure provided with bearing means, and the other has a hub structure provided with no bearing means. The flexbeam having the hub structure but no bearing means, for supporting the rotor blades of the helicopter, comprises a flapping flexible structure disposed at the central portion of the rotor blades in a cruciform configuration, as an example, and a flexible structure extending outwardly from the flapping flexible structure and including a part subjected to feathering and lead-lag motion, which is called a feathering and lead-lag motion part.

U. S. Patent No. 4,427,340 to Metzger et al discloses a flexbeam of the type described above having a flexible structure in which a plurality of parallel ribs extend in the longitudinal direction of the rotor blade of the helicopter and are located in predetermined planes of rotation with spaces therebetween, with a total of eight upper and lower ribs being provided. the ribs thus arranged constitute a reinforced composite integral rib structure, which allows the flexbeam to be easily twisted, and an imaginary hinge portion for the flexbeam is formed for reducing the lead-lag rigidity. Japanese Patent Laid-open Publication (Kokai) No. 55-145811 published November 13, 1980 also discloses a flexbeam which is formed of a fiber composite material having a T-shape or cruciform cross-sectional shape, and in which some members and parts of the composite fiber material as well as joining portions thereof are formed with slits so as to allow the flexbeam to be readily twisted. The structures of the flexbeams disclosed in the prior art references cited above, however, involve problems about weight reduction thereof as well as the productivity or manufacturing cost thereof.

US -A 4 650 401 discloses a flexbeam with a feathering and lead-lag motion part one embodiment of which includes Y-shaped cross section parts. In this embodiment there is provided a lay of monofilament fibers and a woven fiberglass X-shaped fabric. Another embodiment of said US-A-4 650 401 includes a feathering and lead-lag motion part having an X-shaped cross section.

SUMMARY OF THE INVENTION

A first object of this invention is to solve the problems of the conventional technique described above and to provide a flexbeam for rotor blades of a helicopter having a structure of light weight and capable of being easily fabricated.

A second object of this invention is to provide a method for fabricating a flexbeam of the above character.

The first object of this invention can be achieved by providing a flexbeam for a rotor blade of a helicopter, comprising:
a mast mounting and flapping part for connecting with a mast of a drive shaft of an engine mounted on said helicopter; a feathering and lead-lag motion part connected at its inner end to an outer end of said mast mounting and flapping part; and a rotor blade mounting part connected to an outer end of said feathering and lead-lag motion part for installing said rotor blade at an outer end of said rotor blade mounting part, said rotor blade mounting part having bushes for mounting the rotor blade, said feathering and lead-lag motion part being made of a resin impregnated composite fiber material looped around said bushes: characterized in that said feathering and lead-lag motion part comprises an elongated plate-like central member made of a resin impregnated composite fiber material, and a pair of frame members disposed along longitudinal side of and parallel to said central member, said frame members being made of loops of unidirectionally oriented resin impregnated composite fiber material and each having ribs of a Y-shaped cross section, said central member and said frame members being joined integrally along both longitudinal side portions of the central member in such a way that an elongated plate-like intermedicate portion is formed between two Y-shaped cross-sectional portions.

According to the flexbeam described above, the central member made of the composite fiber material and frame members made of unidirectional composite fiber material are effective for resisting shearing stresses due to torsional forces and for axial stresses due to bending forces, respectively, so that the flexbeam is provided with a twistable structure without inside stress and made in thinner structure to be easily formed in a desired configuration.

The second object of this invention can be achieved by a method for fabricating a flexbeam of a helicopter rotor blade, said flexbeam comprising

a mast mounting and flapping part connecting to a mast of a helicopter, a feathering and lead-lag motion part connected to an outer end of said mast mounting and flapping part, and a rotor blade mounting part connected to an outer end of said feathering and lead-lag motion part, opposite to said outer end, for installing the helicopter rotor blade at a pair of bushes provided in a distal end of said rotor blade mounting part, characterized by the steps of: placing between upper and lower mold halves a preliminary cured central member of elongated plate shape made of a pre-preg composite material; placing between said upper and lower mold halves two pairs of the bushes at the two longitudinal end portions of the central member; preparing loops of roving of unidirectionally oriented, half cured, resin impregnated composite fiber material of different length; laying said loops of different lengths along each longitudinal side of said central member such that said loops are laminated in order of length along cavity portions of Y-shaped cross section between the upper and lower mold halves while encircling two bushes which face longitudinally each other; setting side mold halves on respective outside of said loops laminated at said laying step, each side mold half having a shape corresponding to each cavity portion of Y-shaped cross section; and molding said central member and said loops within said upper and lower mold halves and said side mold halves to form an integral flexbeam with ribs of Y-shaped cross section.

Preferred embodiments of this invention will be described further in detail hereunder with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a flexbeam according to one embodiment of this invention;

Figs. 2, 3, and 4 are cross sectional views taken along the lines II-II, III-III, and IV-IV, respectively, shown in Fig 1;

Fig. 5 is a perspective view of a central member and frame members in separate state constituting the flexbeam shown in Fig. 1;

Fig. 6 is a perspective view of a forming device used for forming the frame member from looped elements;

Fig. 7 is a cross sectional view showing the state of integrally molding the central member and the frame members in a mold; and

Fig. 8 is a perspective view of a flexbeam according to another embodiment of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

One embodiment of a flexbeam for a rotor blade of a helicopter according to the invention will be described below with reference to Figs. 1 to 7.

As shown in Fig 1, the flexbeam generally designated by numeral 1 comprises a mast mounting and flapping part 2, feathering and lead-lag motion parts 3, and rotor blade mounting parts 4 each in the form of a flat boss member connected to the respective free ends of the lead-lag motion parts. The mast mounting and flapping part is a flapping flexible structure in the form of a flat boss member disposed at the central portion of the flexbeam arrangement. The feathering and lead-lag motion parts 3 are flexible structures extending in opposing directions from the part 2.

The mast mounting and flapping part 2 is provided with a through hole 6 at the central portion of the flexbeam to be mounted on the mast (not shown) of the helicopter. Each of the feathering and lead-lag motion parts 3 has a substantially H-shaped cross section as shown in Fig. 3, having upper and lower four thin ribs 7 extending in horizontal directions, i.e. in the rotor blade rotating direction. Each of the rotor blade mounting parts 4 has a metallic bush 8 inserted therein and extended vertically for the full thickness of the rotor blade mounting part 4 (see FIG. 2).

The flexbeam 1 is fabricated, as shown in Fig. 5, from a central member 9 made of a woven composite fiber material, and a pair of longitudinally extending frame members 10 disposed along both sides of the central member 9. Each of the frame members 10 is formed of loops at both ends and has a Y-shaped cross section in the region corresponding to the part 3. These members 9 and 10 are formed integrally in a mold and connected with each other along the edges 11a of leg portions 11 of the frame members 10 and the longitudinal opposing surface portions thereof.

The molding operation of the three members 9 and 10, 10 is performed in accordance with the following processes. A pre-preg material of glass fiber, for example, is preliminarily cured to form the central member 9, which is then positioned between lower and upper mold halves 12 and 13 as shown in Fig. 7.

The frame member 10 is formed in accordance with the manner shown in Fig. 6. That is, a fiber reinforced plastic (FRP) roving R is paid out from a reel 14B of a filament winding machine 14 and passed through an impregnation vessel 14A to be impregnated with an epoxy resin, which is contained in the vessel 14A, as an example. The roving R thus impregnated with the epoxy resin is then stretched around pins 14C standing at four

corners of a board member 14D, while being half-cured, to be formed into mutually adjoining and adhering loops of rovings 10a, 10b, - - -. The half-cured looped rovings are then removed from the pins 14 and thereafter placed as they are looped in the mold, as shown in Fig. 7, to be located on the two lateral sides of the central member 9, which is also placed in the mold, in such a manner that the looped rovings are engaged with the metallic bushes 8, which are also placed in the mold, at the end portions thereof. The looped rovings 10a, 10b, - - - and the central member 9 thus set between the mold halves 12 and 13 are then pressed and molded by applying side mold halves 15 as shown in Fig. 7 to be formed into a flexbeam 1.

The frame members thus molded integrally with central member 9, 10 have non-uniform cross sections along the longitudinal direction thereof as shown in Figs. 2 to 4, and the respective fiber materials 10a, 10b, 10c, 10d, - - - forming a unidirectional member have paths different from each other. Accordingly, the respective fiber materials have lengths different from each other, so that it is impossible to form the frame member 10 from only one loop. the frame member 10 can thus be formed by the combined use of various kinds of looped members in conformity with the paths.

According to this embodiment, each of the frame member 10 has cross sectional shapes symmetrical in the vertically and longitudinal directions as viewed, and therefore, the frame member 10 is constituted by four kinds of looped members 10a, 10b, 10c and 10d, i.e. a total of eight looped members, which have lengths different from each other. The frame member 10 can be easily formed by laying the respective looped members 10a to 10d in this order to the predetermined positions in the mold 12, 13 and 15.

According to this embodiment, the two feathering and lead-lag motion parts 3 are coupled with both the ends of the mast mounting and flapping part 2 to form a single flexbeam 1, and therefore an overlapped arrangement of a pair of the thus formed flexbeams 1 constitutes blade rotors having four blades.

Fig. 8 shows a perspective view of a flexbeam for a rotor blade of a helicopter according to another embodiment of this invention, in which a feathering and lead-lag motion part 3A is coupled with only one end of a mast mounting and flapping part 2A to constitute a flexbeam 1A. In the embodiment illustrated in Fig. 8, the mast mounting and flapping part 2A is provided with three sides, so that three flexbeam 1A can be mounted via fittings (not shown) to the mast mounting and flapping part 2A arranged centrally of the three flexbeams, whereby the three rotor blades can be mounted thereto.

According to the flexbeams for the rotor blades of a helicopter of the embodiment having constructions described above, the flexbeam can be provided with relatively long cross sectional size in the direction of rotation thereof, so that the required lead-lag rigidity can be achieved with a small cross sectional area, whereby the flexbeam can be constructed so as to have a light weight. In addition, since the vertical spaces between the respective rib elements 7 can be relatively freely set, the required flapping rigidity can also be attained without substantially changing the lead-lag rigidity.

Moreover, from a view point of the strength, the central member made of the composite fiber material is utilized mainly for resisting shearing stresses due to torsional forces, and the frame members made of the unidirectional composite fiber material are utilized mainly for resisting axial stresses due to bending forces, so that the cross sectional thickness of the entire combined elements can be made to have a thin structure, the entire structure of the flexbeam can be made to be twisted easily, and the stresses applied thereto can be reduced without having to provide any slits or the like.

The central member is easily manufactured with the desired dimensions since it is made of the composite fiber material and can be utilized as a core when the central member is located in the mold, so that the area of the projecting four rib elements is enough to ensure the integral molding of the flexbeam structure in predetermined positions. An abtuse formation of the fillet portions of the respective rib elements ensures easy pressing operation and easy departing operation of the product from the mold.

Furthermore, the frame member having rib elements made of unidirectional composite fiber material can be effectively bear centrifugal forces, so that the frame member can be constructed to from a bilateral pair of flexbeams supporting the rotor blades respectively with the centrally arranged mast mounting and flapping part in-between, or to form a plurality of cantilevered flexbeams including looped materials engaging a metallic bush arranged centrally, whereby any numbers of blade rotors can be mounted.

Claims

1. A flexbeam for a rotor blade of a helicopter, comprising: a mast mounting and flapping part (2) for connecting with a mast of a drive shaft of an engine mounted on said helicopter; a feathering and lead-lag motion part (3) connected at its inner end to an outer end of said

mast mounting and flapping part (2); and a rotor blade mounting part (4) connected to an outer end of said feathering and lead-lag motion part (3) for installing said rotor blade at an outer end of said rotor blade mounting part, said rotor blade mounting part (4) having bushes (8) for mounting the rotor blade, said feathering and lead-lag motion part (3) being made of a resin impregnated composite fiber material looped around said bushes (8):

characterized in that said feathering and lead-lag motion part comprises an elongated plate-like central member (9) made of a resin impregnated composite fiber material, and a pair of frame members (10) disposed along longitudinal sides of and parallel to said central member (9), said frame members being made of loops of unidirectionally oriented resin impregnated composite fiber material and each having ribs (7) of a Y-shaped cross section, said central member (9) and said frame members (10) being joined integrally along both longitudinal side portions of the central member in such a way that an elongated plate-like intermediate portion (9, 11a) is formed between two Y-shaped cross-sectional portions.

2. The flexbeam according to claim 1, wherein said elongated frame members (10) have leg portions (11) at both ends, and the leg portions (11) have respective longitudinal edges (11a) integrally joined to the central member (9).

3. The flexbeam according to claim 1, wherein said frame members have symmetrical cross sectional shapes.

4. The flexbeam according to claim 1, wherein said loops have lengths different from each other.

5. A method for fabricating a flexbeam of a helicopter rotor blade, said flexbeam comprising a mast mounting and flapping part (2) connecting to a mast of a helicopter, a feathering and lead-lag motion part (3) connected to an outer end of said mast mounting and flapping part (2), and a rotor blade mounting part (4) connected to an outer end of said feathering and lead-lag motion part (3), opposite to said outer end, for installing the helicopter rotor blade at a pair of bushes (8) provided in a distal end of said rotor blade mounting part (4), characterized by the steps of: placing between upper and lower mold halves (13, 12) a preliminary cured central member (9) of elongated plate shape made of a pre-preg composite material; placing between said upper and lower mold halves (13, 12) two pairs of the bushes (9) at the two longitudinal end portions of the central member (9); preparing loops (10a,...10d) of roving of unidirectionally oriented, half-cured, resin impregnated composite fiber material of different length; laying said loops (10a,...10d) of different lengths along each longitudinal side of said central member (9) such that said loops are laminated in order of length along cavity portions of Y-shaped cross section between the upper and lower mold halves (13, 12) while encircling two bushes (8) which face longitudinally each other; setting side mold halves (15) on respective outside of said loops (10a...10d) laminated at said laying step, each side mold half (15) having a shape corresponding to each cavity portion of Y-shaped cross section; and molding said central member (9) and said loops (10a,...10d) within said upper and lower mold halves (13, 12) and said side mold halves (15) to form an integral flexbeam (1) with ribs (7) of Y-shaped cross section.

6. The method according to claim 5, wherein said preparing step further comprises:
providing a filament winding machine including a board member (14D), four pins (14C) standing at four corners of said board member (14D), a vessel (14A) containing an epoxy resin and a reel (14B) binding fiber reinforced plastic roving (R); impregnating said roving (R) paid out from said reel (14B) with said epoxy resin in said vessel (14A); and stretching and winding said roving (R) coming out from vessel around said four pins to be formed into mutually adjoining and adhering loops.

Patentansprüche

1. Biegeplatte eines Hubschrauberrotorblatts mit einem Säulenbefestigungs- und Schlagteil (2) zur Verbindung mit einer Säule einer Antriebswelle eines Motors, der an dem Hubschrauber befestigt ist, einem federnden Voreil-Nacheil-Bewegungsteil (3), der an seinem inneren Ende mit einem äußeren Ende des Sälenbefestigungs- und Schlagteils (2) verbunden ist, und einem Rotorblattbefestigungsteil (4), der mit einem äußeren Ende des federnden Voreil-Nacheil-Bewegungsteils (3) verbunden ist, um das Rotorblatt an einem äußeren Ende des Rotorblattbefestigungsteils anzubringen, wobei der Rotorblattbefestigungsteil (4) Buchsen (8) zur Befestigung des Rotorblatts hat und der federnde Voreil-Nacheil-Bewegungsteil (3), der aus einem

harzimprägnierten Verbundfasermaterial besteht, in Schlaufen um die Buchsen (8) gelegt ist,
dadurch gekennzeichnet,
daß der federnde Voreil-Nacheil-Bewegungsteil ein langgestrecktes, plattenähnliches zentrales Element (9) aus einem harzimprägnierten Verbundfasermaterial und zwei Rahmenelemente (10) aufweist, die entlang den Längsseitigen des zentralen Elementes (9) parallel zu diesem angeordnet sind, daß die Rahmenelemente aus Schlaufen eines einseitig orientierten, harzimprägnierten Verbundfasermaterials hergestellt sind und jeweils Ripen (7) eines Y-förmigen Querschnitts haben und daß das zentrale Element (9) und die Rahmenelemente (10) integral entlang beider Längsseitenabschnitte des zentralen Elementes in der Weise zusammengefügt sind, daß ein langgestreckter, plattenähnlicher Zwischenabschnitt (9, 11a) zwischen zwei Y-förmigen Querschnittsabschnitten geformt ist.

2. Biegeplatte nach Anspruch 1, wobei die langgestreckten Rahmenelemente (10) Armabschnitte (11) an beiden Enden haben, deren jeweilige Längsränder (11a) integral mit dem zentralen Element (9) zusammengefügt sind.

3. Biegeplatte nach Anspruch 1, wobei die Rahmenelemente symmetrische Querschnittsformen haben.

4. Biegeplatte nach Anspruch 1, wobei die Schlaufen jeweils unterschiedliche Längen haben.

5. Verfahren zur Fertigung einer Biegeplatte eines Hubschrauberrotorblatts, wobei die Biegeplatte einen Säulenbefestigungs- und Schlagteil (2), der mit einer Säule eines Hubschraubers verbunden ist, einen federnden Voreil-Nacheil-Bewegungsabschnitt (3), der mit einem äußeren Ende des Säulenbefestigungs- und Schlagteils (2) verbunden ist, und einen Rotorblattbefestigungsteil (4) aufweist, der mit einem äußeren Ende des federnden Voreil-Nacheil-Bewegungsabschnitts (3) verbunden ist, gegenüber dem äußeren Ende, um das Hubschrauberrotorblatt an zwei Buchsen (8) anzubringen, die an einem entfernten Ende des Rotorblattbefestigungsteils (4) vorgesehen sind,
gekennzeichnet durch folgende Schritte:
Anordnen eines vorläufig gehärteten zentralen Elements (9) einer langgestreckten Plattenform aus einem Vorimprägnierverbundmaterial in oberen und unteren Formhälften (13, 12); Anordnen zweier Paare von Buchsen (8) an den zwei longitudinalen Endabschnitten des zentralen Elementes (9) zwischen den oberen und unteren Formhälften (13, 12); Vorbereiten von Schlaufen (10a, ...10d) von Rovings eines einseitig orientierten, halb gehärteten, kunststoffimprägnierten Verbundfasermaterials unterschiedlicher Länge; Legen der Schlaufen (10a,...10d) unterschiedlicher Längen entlang jeder longitudinalen Seite des zentralen Elementes (9) auf solche Weise, daß die Schlaufen in der Reihenfolge der Länge entlang den Hohlraumabschnitten eines Y-förmigen Querschnitts zwischen den oberen und unteren Formhälften (13, 12) geschichtet sind, während sie zwei Buchsen (8) umgreifen, die in Längsrichtung einander zugewandt sind; Anbringen von Seitenformhälften (15) an der jeweiligen Außenseite der Schlaufen (10a...10d), die in dem Legeschritt geschichtet sind, wobei jede Seitenformhälfte (15) eine Form hat, die jedem Hohlraumabschnitt des Y-förmigen Querschnitts entspricht; und Formen des zentralen Elementes (9) und der Schlaufen (10a...10d) in den oberen und unteren (13, 12) und seitlichen Formhälften (15), um eine integrale Biegeplatte (1) mit Rippen (7) eines Y-förmigen Querschnitts auszubilden.

6. Verfahren nach Anspruch 5, wobei der vorbereitende Schritt ferner umfaßt:
Anordnen eines Faserwickelgerätes mit einer Platte (14D), vier Stiften (14C), die an vier Ecken der Platte (14D) stehen, einem Gefäß (14A), das Epoxidharz enthält, und einer Spule (14B), die ein faserverstärktes Kunststoffgespinst (R) enthält; Imprägnieren des Gespinstes (R), das von der Spule (14B) abgegeben wird, mit dem Epoxidharz des Behälters (14A); und Spannen und Wickeln des Gespinstes (R), welches von dem Gefäß kommt, um die vier Stifte, um aneinander angrenzende und anhaftende Schlaufen zu bilden.

Revendications

1. Lame de flexion pour pale de rotor d'hélicoptère, comprenant: une pièce de montage sur le pylône et de battement (2) destinée à être reliée à un pylône d'un arbre d'entraînement d'un moteur monté sur l'hélicoptère; une pièce de variation de pas et de mouvement d'avance et de recul (3) reliée à son extrémité interne à une extrémité externe de ladite pièce de montage et de battement (2), et une pièce de fixation de pale de rotor (4) reliée à une extrémité externe de ladite pièce de variation de pas et de mouvement d'avance et de recul (3)

pour fixer ladite pale de rotor à une extrémité externe de ladite pièce de fixation de pale du rotor (4), cette dernière comportant des douilles (8) pour la fixation de la pale du rotor, ladite pièce de variation de pas et de mouvement d'avance et de recul (3) étant faite d'un matériau composite formé, de fibre imprégnées de résine entourant lesdites douilles (8):

caractérisé en ce que ladite pièce de variation de pas et de mouvement d'avance et de recul comprend un élément médian (9) en un matériau composite formé de fibres imprégnées de résine, et deux éléments d'encadrement (10) disposés le long de côtés longitudinaux dudit élément médian (9) et parallèlement à ce dernier, lesdits éléments latéraux d'encadrement étant formés de boucles d'un matériau composite formé de fibres orientées de façon unidirectionnelle et imprégnées d'une résine et ayant des nervures (7) ayant en section transversale la forme d'un Y, ledit élément médian (9) et lesdits éléments d'encadrement (10) étant réunis de façon solidaire le long des deux parties latérales longitudinales de l'élément médian, de manière qu'une partie intermédiaire allongée en forme de plaque (9,11a) soit formée entre les deux parties ayant en section transversale la forme d'un Y.

2. Lame de flexion suivant la revendication 1, dans laquelle lesdits éléments d'encadrement allongés (10) ont des branches (11) à leurs deux extrémités, et les branches (11) ont des bords longitudinaux respectifs (11a) solidaires de l'élément médian (9).

3. Lame de flexion suivant la revendication 1, dans laquelle les éléments d'encadrement ont des formes symétriques en section transversale.

4. Lame de flexion suivant la revendication 1, dans laquelle lesdites boucles ont des longueurs différentes les unes des autres.

5. Procédé de fabrication d'une lame de flexion d'une pale de rotor d'hélicoptère, cette lame de flexion comprenant une pièce de montage sur le pylône et de battement (2) reliée à un pylône d'un hélicoptère, une pièce de variation de pas et de mouvement d'avance et de recul (3) reliée à une extrémité externe de ladite pièce de montage sur le pylône et de battement (2), et une pièce de fixation de pale de rotor (4) reliée à une extrémité externe de la pièce (3), à l'opposé de ladite extrémité externe, pour monter la pale du rotor sur deux douilles (8) prévues à une extrémité distale de la pièce (4),

caractérisé par les phases suivantes:

- on dispose entre des moitiés supérieure et inférieure (12,13) d'un moule un élément médian de forme allongée plate (9) fait d'un matériau composite pré-imprégné;
- on place entre lesdites moitiés supérieure et inférieure (12,13) du moule deux paires de douilles (9) aux deux parties d'extrémité longitudinales de l'élément médian (9);
- on prépare des boucles (10a,...10d) de mèches de différentes longueurs d'un matériau composite formé de fibres orientées de façon unidirectionnelle, imprégnées de résine et à demi polymérisées et on dispose lesdites boucles (10a,...10d) le long de chaque côté longitudinal de l'élément médian (9) de manière que lesdites boucles soient stratifiées par ordre de longueurs le long des parties creuses de la section transversale en forme de Y entre les moitiés supérieure et inférieure (12,13) du moule tout en entourant deux douilles (8) qui se font face longitudinalement l'une l'autre;
- on pose des moitiés latérales de moule (15) sur l'extérieur desdites boucles (10a,...10d) disposées de façon stratifiée au cours de la phase précédente, chaque moitié latérale de moule (15) ayant une forme qui correspond à chaque partie creuse de la section transversale en forme de Y; et
- on moule l'élément médian (9) et les boucles (10a,...10d) dans les moitiés supérieure et inférieure du moule (12,13) et lesdites moitiés latérales (15) du moule afin de former une lame de flexion d'une seule pièce (1) ayant des nervures (7) présentant en section transversale la forme d'un Y.

6. Procédé suivant la revendication 5, dans lequel, en outre, dans ladite phase de préparation:

- on prévoit une machine pour enrouler un filament comprenant une plaque (14d), quatre doigts (14c) dressés aux quatre angles de la plaque (14d), un récipient (14A) contenant une résine époxy et un rouleau (14B);
- on lie une mèche (R) de fibres renforcées de matière plastique;
- on imprègne la mèche (R) déroulée du rouleau (14B) avec la résine époxy

contenue dans le récipient (14A); et

- on étire et on enroule la mèche (R) provenant du récipient autour des quatre doigts afin de la former en des boucles adjacentes et adhérant ensemble.

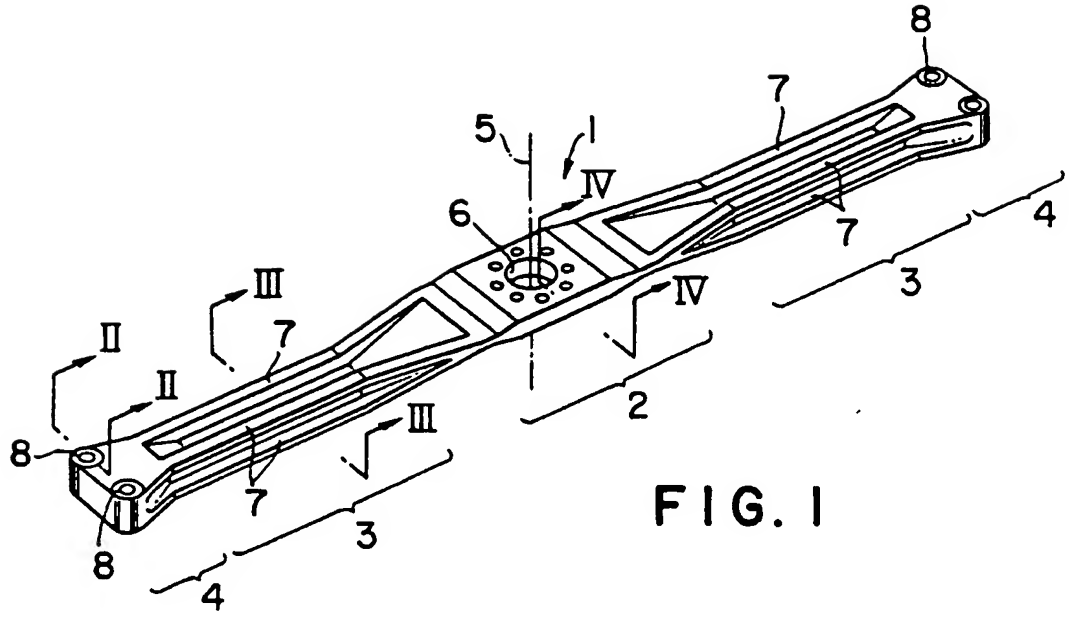

FIG. 1

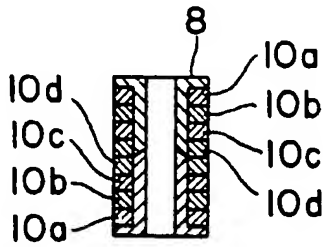

FIG. 2

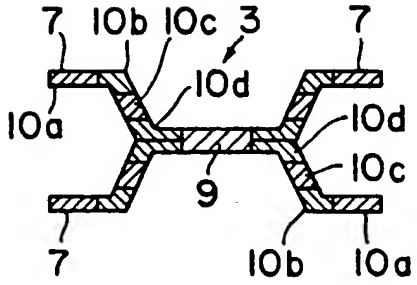

FIG. 3

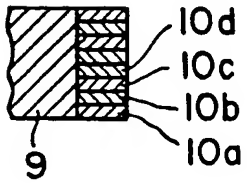

FIG. 4

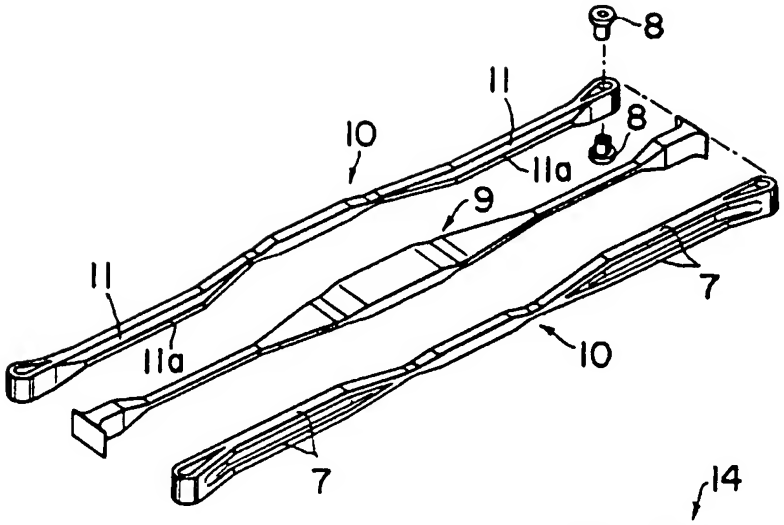

FIG. 5

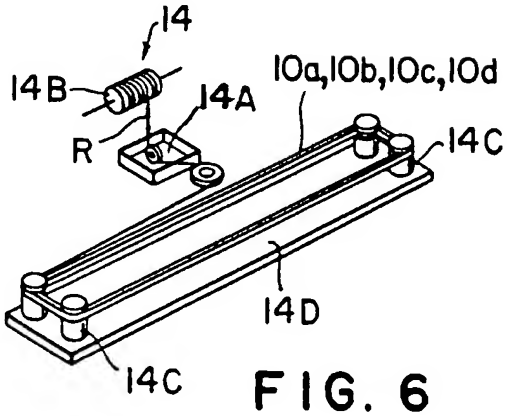

FIG. 6

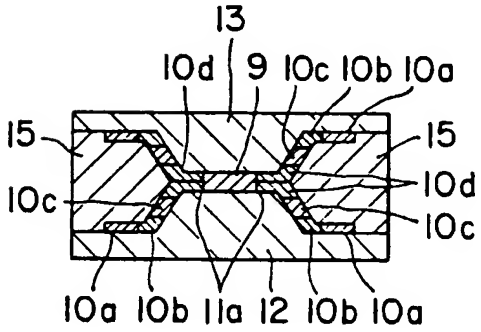

FIG. 7

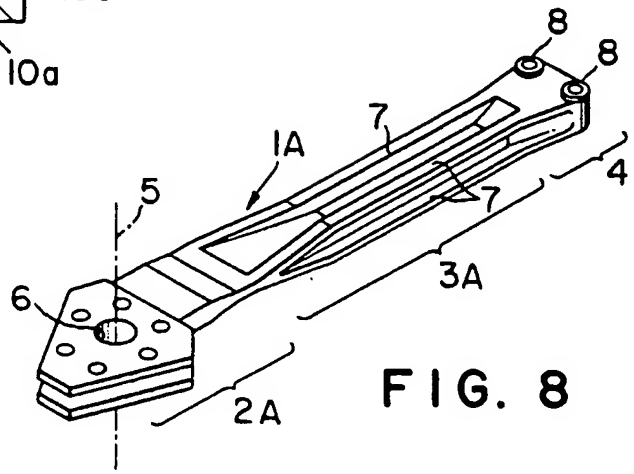

FIG. 8